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## COAL MINING IN CHINA

By Dr. ALFRED C. REED

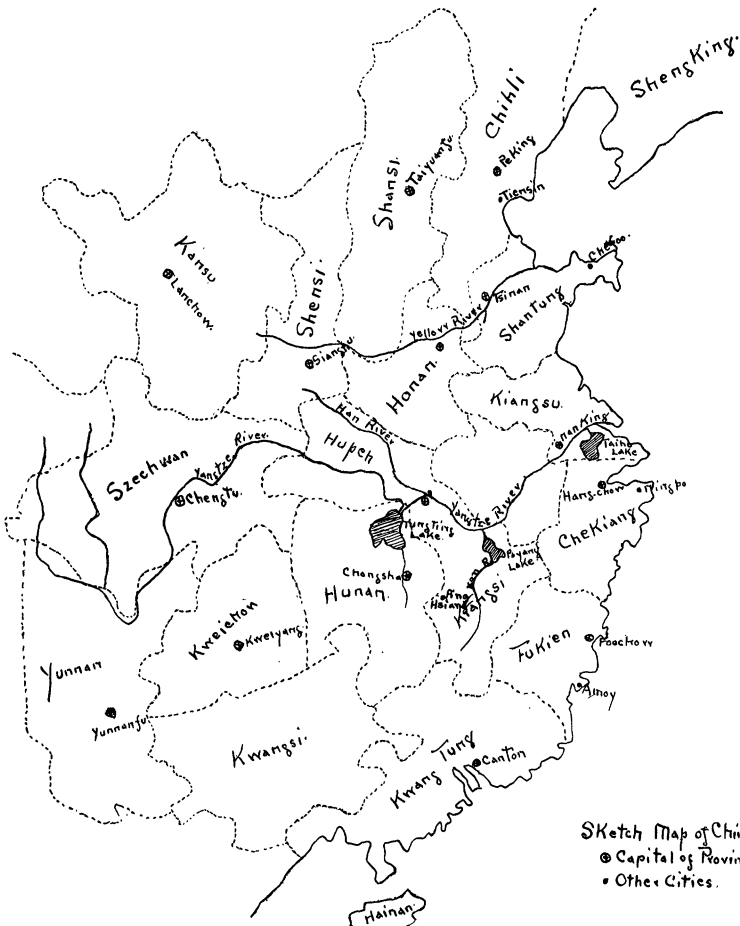
SAN FRANCISCO

THE great central valley of China, extending from Thibet in the far west to the Yellow Sea, is drained by the Yang Tze River and its tributaries. South of that part of the Yang Tze which flows through the mid-part of the eighteen provinces is a vast section centering in the province of Kiangsi and extending southward to the ranges cutting off the watershed of the South China coast, in which are some of the most extensive coal fields in the world. This southern watershed crosses the extreme south of Kiangsi and Hunan. Practically all of Kiangsi and the southern section of Hunan have large coal deposits as well as abundant iron and limestone, and more or less extensive quantities of antimony, manganese, lead, copper and silver.

The largest coal mine in China, the Ping Hsiang Colliery, was started in 1894 on the site of native diggings which had been worked for unknown ages near Ping Hsiang in Kiangsi. Five miles from this walled city is the village of An Yuen, the terminus of a railroad running to Changsha, the capital of Hunan. At this village, 90 miles from Changsha, is the Ping Hsiang Colliery, which produces 2,400 tons of coal and 700 tons of coke daily, and employs 9,000 men. An Yuen lies on the watershed between the Siangtung River running west into the Siang River in Hunan which empties through the Tung Ting Lake into the Yang Tze, and the Siu River running east into the Kan River in Kiangsi, which empties through the Poyang Lake into the Yang Tze. Southeast of the village is the high range of the Lo Siao Mountains in which are the coal fields. This range varies in altitude from one to two thousand feet, and the main level of the colliery in the valley is about 500 feet above the sea-level at Shanghai. The Ping Hsiang colliery is in east longitude 114 degrees and in north latitude 27 degrees and 30 minutes. The one way of approach is through Hunan where large river steamers from Hankow reach Changsha. The railroad from Changsha to An Yuen is part of the Canton-Hankow system which originally was an American concession, but later was transferred to the British. Only this section, with short spurs

at either end from Hankow and Canton, has so far been completed after many years of wordy strife and paper planning. A new British concession has, however, been granted to connect Changsha with Ningpo by way of Ping Hsiang, with a branch midway to Hankow. This would open up vast deposits of coal and iron now practically inaccessible.

The Ping Hsiang Colliery supplies the coke for the Hanyang Iron Works, which are across the mouth of the Han River from Hankow. The coal output is distributed to the territory from Changsha and Siangtan to Hankow and even further down the Yang Tze. Both coke and coal are transported by rail from An Yuen to Chuchow on the Siang River, where they are loaded on junks and lighters for further transportation. The technical operation of the Ping Hsiang colliery is under the direction of a

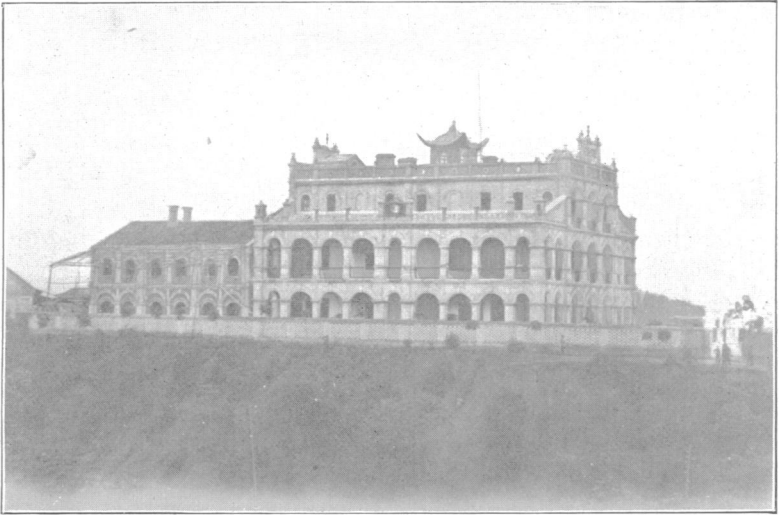


staff of twelve German engineers who are applying the most up-to-date methods of mining and coal preparation. In its twenty years under foreign supervision the colliery has grown to extensive proportions. Improvements now under construction will within six months increase the output to 3,500 tons per day. Entrance to the mine is twofold, first, by way of the main adit going straight into the mountain for a distance of 2,500 meters horizontally from the floor of the valley, and second, by a pair of shafts 300 and 500 feet deep, respectively. The shaft division is the older and smaller and its output is about 700 tons per day. It includes only the deeper levels where the seams dip below the level of the main adit. The bulk of the mine, reached through the main adit, is above the level of the valley floor and comprises a total of five levels, each with numerous lateral drifts following in each seam. The highest level is near the summit of the chief mountain of the range, and egress to the outer air could easily be obtained at many points.

The main adit runs straight into the mountain for a distance of 2,000 meters before reaching the main or lowest level, where a wide haulage way runs at right angles to it. The adit has two parallel tracks for an electric tramway running its full length, which in the outer 200 meters are increased to eight tracks. Here the first electric railway in China was put into operation fifteen years ago, and has been maintained ever since. The trains attain a speed of twenty-five miles per hour.



SKETCH MAP OF THE PROVINCES OF HUNAN AND KIANGSI.



ADMINISTRATION BUILDING, PING HSIANG COLLIERY.

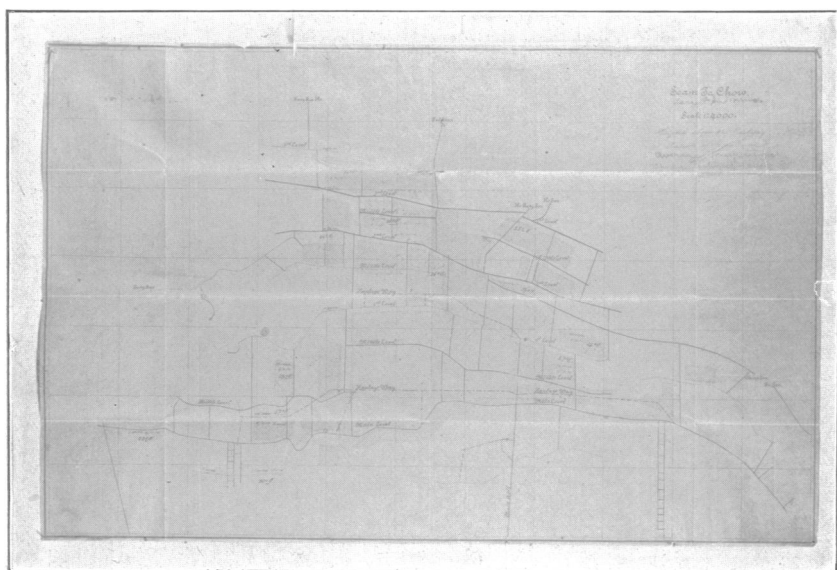
The coal seams run in three groups. The first group encountered by the main adit has the thickest seams and these are inclined at an angle of twenty degrees to the adit. At the junction of the adit and first group of coal veins is the main level of the mine running transversely to the adit, with lateral drifts following the seam up and down according to its inclination. Five hundred meters past the point where it pierces the first group of coal veins, the main adit pierces a second and smaller group inclined also at an angle of twenty degrees and parallel to the first group. Still deeper in the mountain is a third group which has been worked out.

The seams are thus all transverse to the main adit and inclined upward and away from it at a 20-degree angle. Lateral inclined drifts from the main level follow up each seam for from 120 to 160 meters to the first level, which runs horizontally in the plane of the seams, and in turn has lateral inclined drifts following the seams. The first level is connected with the main level not only by the inclined drifts following the seams, but also by vertical shafts. Higher yet in the line of the seams are the second, third and fourth levels, the last being well toward the summit of the range. The accompanying sketches show the inclination of the seams and the general schematic relations of the main adit and shaft to the various levels.

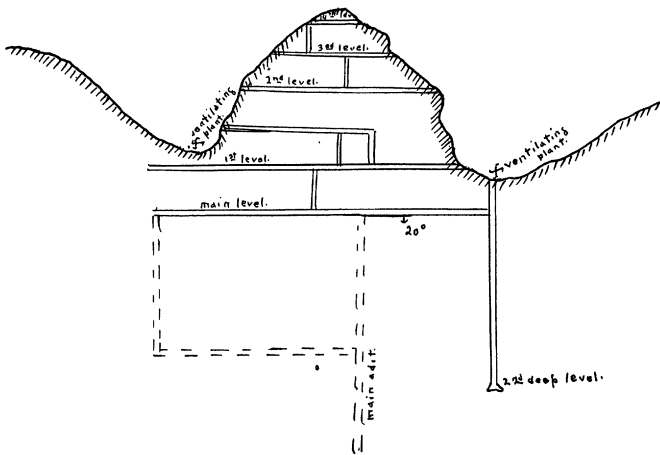
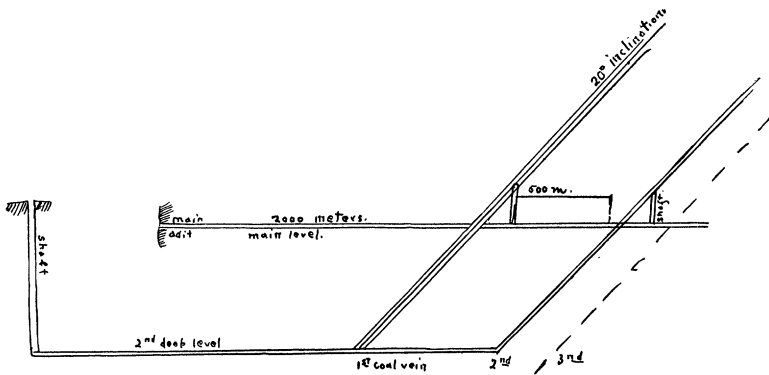
Below the level of the main adit there are two deep levels, communicating with the main level, but with haulage ways tributary to the double shaft. The arrangement of these deep levels

and the manner of communication between them, by means of lateral inclined drifts in the seams, are similar to the arrangement in the upper levels. The general lay-out of the mine as well as its operation is simplified by the fact that the two groups of coal veins, a little below the main level, are turned at an angle of 90 degrees still however maintaining their original inclination. This enables the combination of approach by a shaft and by a horizontal main adit to be most effective and also facilitates the ventilation. At present the ventilation is maintained by a combination of compressed air piped throughout the mine, together with two large air-heating furnaces which establish a strong upward draft. A new system of electric blowers is now being installed. The ventilation is remarkably good for so extensive a field of operation.

Among the drawbacks are the prevalence of mine fires, which are controlled by sealing off the entire section with several meters of wet clay, and faults in the strata which occur at various points and necessitate abrupt changes in drifts and elevations. A picture is shown herewith which illustrates a fault where the strata have not been broken, but have been bent through an angle of 90 degrees. The equipment for fighting mine-gas and fires is the same as in western countries and oxygen helmets are always at hand in the two rescue stations for emergencies.

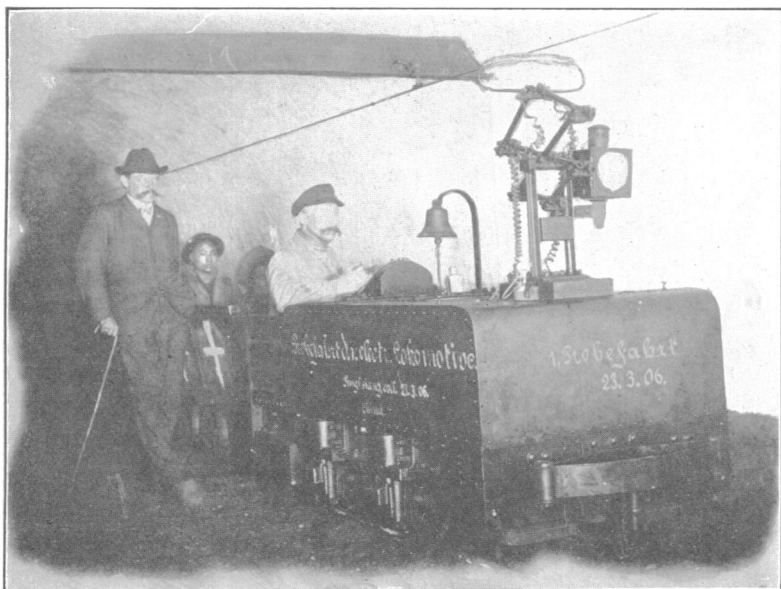


THE LACHOW SEAM OF THE PING HSIANG COLLIERY. The drawing is not sufficiently clear to give a good reproduction, but the general arrangement of the levels is shown.



ELEVATIONS OF MINE.

Throughout the mine heavy timbering is necessary, and this constitutes one of the chief items of operating expense. In the seams and in very soft strata, a layer of pine twigs and straw is placed between the wall and roof and the heavy timbering to prevent coal dust and sand from working between the timbers and producing excavations of constantly growing proportions. With these fagots of twigs and straw countless insects are brought in. Scorpions six inches in length are fairly common but stings are infrequent. Cockroaches swarm by the millions and furnish part of the regular diet of the hosts of rats which find in the warm dark mine a safe abiding-place. Ants also are a great annoyance to the miners.



ELECTRIC LOCOMOTIVE, MANUFACTURED AND USED IN PING HSIANG COLLIERY.

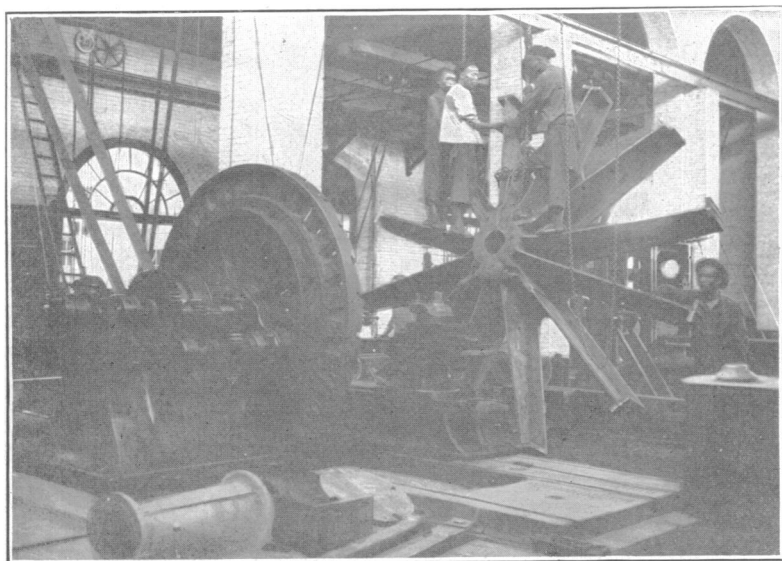
The above-ground works of the Ping Hsiang Colliery are extensive and modern. The freshly mined coal is taken on the tram-ways directly to the two washing plants, one for the shaft and one for the main adit. Here it is elevated to the top of the building, thoroughly mixed with water, cleaned, separated from slate, schist, clay and sand, and graded into various sizes. As only bituminous coal occurs, a large percentage is in the form of dust, and this is washed as thin slime into large sedimentation tanks thirty-five feet in depth. From the bottom of these tanks it is scraped by chain elevators, and deposited in storage tanks from which it is carried as a wet solid mass to the coke ovens. No anthracite is found and the soft coal is of such quality as to produce coke of the best quality, of excellent hardness and which fractures in large pieces, considerations of importance in the steel manufactory.

The foreign coke ovens number 262, each of which produces five tons of coke every forty-eight hours, giving a total output of about 700 tons of coke per day. Part of the gas from the coke ovens is used for developing electric power, but so far no other utilization of by-products has been introduced. There is a shameful waste here, as one ton of coal produces during the carbonizing process about 10,000 cubic feet of gas, fifteen to twenty-five pounds of ammonium sulphate, and from four to eight gallons of tar. But capital is hard to secure in central China and

the cost of the machinery installation necessary to secure these by-products is estimated at a million dollars gold.

Large and well-equipped machine shops turn out most of the machinery used in the colliery, including engines, pumps and tools. Many of the shop lathes and drilling machines were made here. All the car wheels and other castings necessary in so large a plant are cast in the local foundry. Electric power is developed for all purposes in the colliery. Another industry within an industry is found at the large brick yards on the mountain side not far from the colliery. Here the clay is pressed by hand and kiln-dried. The bricks are carried to all parts of the mine by coolies.

A total of nearly 9,000 men are employed, of whom about 6,000 work underground. Two shifts are run of twelve hours each. Work is suspended, not on Sundays, but on the first and fifteenth of each month. The coolies who work underground are divided into gangs of from ten to a hundred men each, according to the situation of their work. Each gang has its headman. About ten gangs, depending on their size, make up a section. Each tram-car of coal which leaves the mine is marked with the number of the gang which mined it and is credited to that gang. In drifts through rock and earth, the gang is paid according to meter of length and according to whether the drift is of single, or double, track caliber. A single track drift has a cross section of about 2.5 square meters. The absolute size of



MACHINE SHOPS. LARGEST SINGLE CASTING MADE AT PING HSIANG COLLIERY.



END OF A DRIFT.

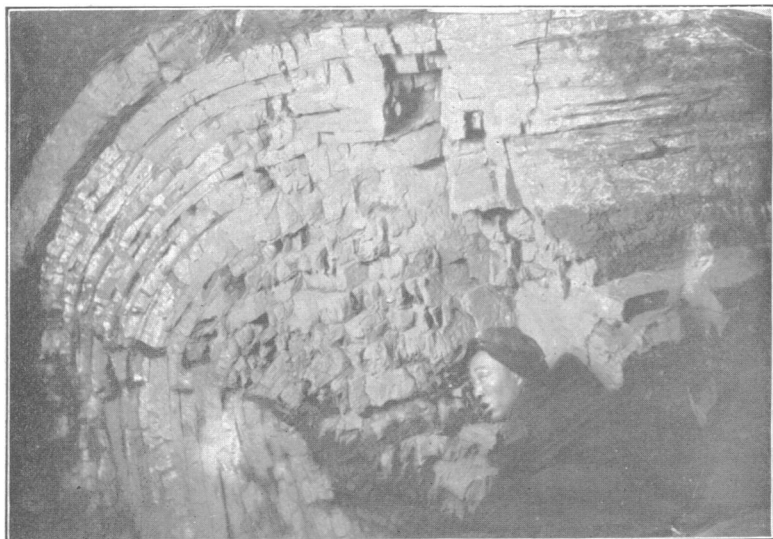
the drift is determined by the amount of air which must pass through it for efficient ventilation.

No coolie will do more than one kind of work. One set does timbering alone. Another cuts coal. Another does the carrying in baskets, and pushing the tram-cars in drifts not fitted with electric or cable propulsion. Next come the miners who do the coal and rock cutting, then the coolies who scrape the coal and débris into baskets and carry it out. It is a strange fact that the shovel is unknown in China. Everywhere and for every purpose for which a western laborer would use a shovel the coolie uses an implement half between a mattock and a hoe, with which he scrapes the earth or whatever it may be into shallow baskets. The wage of the mine coolies averages twenty cents Mex., about nine cents gold, per day; the miners about thirty cents, thirteen cents gold; for the twelve-hour shift. The coolies live in company boarding houses where they are a little better under control. The cost per man for board and lodging is about eight cents Mex. per day, to which must be added four and one half cents per day for oil for lights in the mine. The total expense to the company is thus between forty-five and fifty cents Mex. per day for each coolie. Each section in the mine has four overseers, including one apprentice. Every effort is made by the foreign staff to develop native mining engineers and to this end apprentices are employed throughout the works, who later receive both theoretical and practical instruction in mining engineering and foreign languages.

The output of coal per miner is somewhat under one half ton per day in distinction to the European average of one ton per day and more, and this is in spite or perhaps partly because of the long hours and infrequent holidays. Indeed many factors contribute to this result, among which may be mentioned very prominently the presence of hookworm infection in high degree. The mine coolies are much better housed and fed by the company than if left to their own resources, but their physical capacity is quite limited. The methods of drilling and blasting are similar to those in western countries.

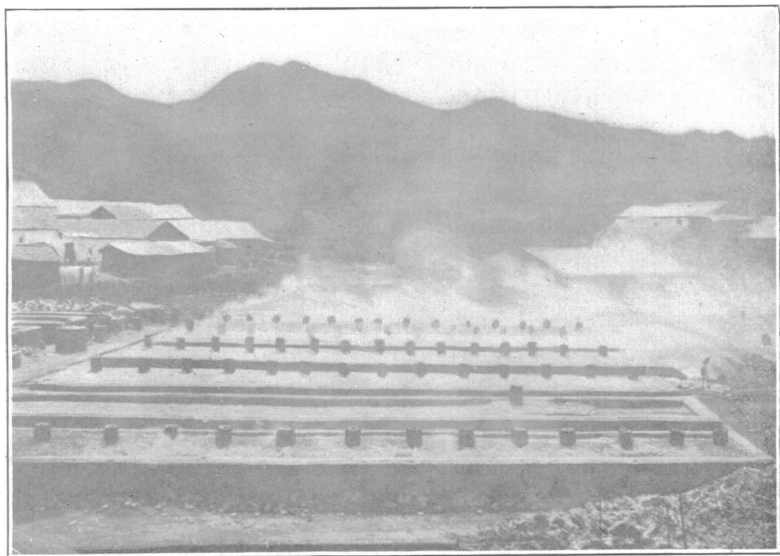
The coolie class is intractable, unreliable, and has no outlook either as to their own or their country's future. They reflect in a petty way the same qualities which now and always have been too much in evidence among their countrymen in higher circles. "Face," "squeeze" and dishonesty are the crying vices of the Chinese people, and it is these particular qualities which make foreign development of China most difficult and which make absolutely imperative an actual and effective supervision of foreign loans to China.

Just south of the washing plants and coke-burning kilns of the Ping Hsiang Colliery is an area of perhaps five acres enclosed by a high brick wall and given over to coke production according to native methods. The "beehive," or native ovens, differ radically from the foreign and no machinery is used in filling or emptying them. The human beast of burden does



A FAULT, IN WHICH THE STRATA ARE BENT BUT NOT BROKEN. Photograph in Ping Hsiang Colliery.

everything by simple force of numbers and persistence. The native kiln is constructed in a unique but effective manner. A long trench is formed about 12 feet wide and from 20 to 50 yards in length, by two brick walls some 30 inches in height. These retaining walls are about the thickness of two brick lengths, and at intervals of perhaps 8 feet are fitted with apertures a foot wide by 18 inches high through which the firing is started.



NATIVE "BEEHIVE" COKE OVENS BURNING. Coal-bearing range in background.

These broad and comparatively shallow trenches are provided with a smooth floor of packed clay and are then filled solid with wet coal dust except for a small space left opposite each aperture in the retaining walls. Every bit of the coal is carried by coolies in small baskets balanced on poles across the shoulders. The coal is of first quality, coming from the washing plants of the Ping Hsiang colliery. The trenches are filled to a depth of two and a half feet and then rows of brick are laid on edge over the entire surface, and on these a second layer of brick are laid flat covering the entire space. Along the center of the trench at points midway between the firing apertures in the retaining walls, small flues are made with brick, and then the entire surface is covered with sand. By means of a little lump coal and wood, fires are now started in each of the firing apertures, and soon the entire interior of the trench, forming a single long low kiln, is in process of combustion. A good draught is

quickly established between the firing apertures and the flues, and the gases are quite thoroughly consumed. From the entire area a thin cloud of smoke and vapor rises, but there is remarkably little unoxidized material. The heat evolved is a total waste except for its value for the coolies' cooking.

Even more interesting than the "beehive" coke ovens are the native coal mines, of which there are large numbers in southern Hunan and southwestern Kiangsi. In the coal fields near Ping Hsiang there are numerous native mines on both sides of the range. These native mines are a sore grievance to the Ping Hsiang colliery because of drainage conditions. The native mines are always located where the coal seams pinch out at the surface, and are always comparatively shallow, seldom extending more than a few hundred feet into the mountain. Their slanting shafts quite thoroughly collect most of the surface waters which are held above the clay strata overlying the deeper drifts of the large colliery. The upper levels of the colliery naturally approach nearest the surface at the localities where the coal seams outcrop. The result is that the surface waters collected in large quantity by the native mines are drained off to a great degree by the upper levels and drifts of the colliery and these highest parts of the colliery are consequently the wettest by far. The native mines are frequently however in a state of practical flood. The description here given is based on an extensive investigation covering upwards of 200 native mines, undertaken by Mr. M. Esterer, of the Ping Hsiang Colliery.

In digging shafts and laterals, the native miner avoids rock so far as possible, though he has copied foreign methods of drilling and blasting. The diggings are largely in the seams and consequently have many tortuous and narrow passages. The shaft of the native mine follows the vein from the surface, usually at an inclination of from 20 to 60 degrees. After a varying distance the shaft or drift becomes horizontal and then rises, still following the vein. The result is the formation of an elbow towards which the water flows from both directions. This necessitates constant pumping to keep the passage open, and even then the water stands from one to two feet deep for a variable distance. Through this water every person must walk on entering and leaving the mine. Pumping is effected by manpower, as machinery is never used. A long section of a large bamboo, 6 to 8 inches in diameter, is cleaned out, making a circular smooth pipe. Into one end of this a crude valve is fitted and into the opposite end is introduced a piston with valve. This pump is laid along the slanting floor of the shaft and



MR. CHANG. Chinese Founder of Ping Hsiang Colliery.

operated by a coolie who sits at its upper extremity. The water is caught in a small pool lined with clay from which it is pumped by a second similar apparatus at a higher level. A sufficient number of these relay bamboo pumps are provided to reach the surface.

As the shafts are never vertical and all work is done by man-labor, some special means is necessary for transporting the coal to the surface. Bamboo or plain wooden ladders with the rungs characteristically close together, so that each step is not over 6 to 10 inches, are laid against the sloping floor and secured by pegs or bamboo withes. The upright side pieces of these ladders are very close together, leaving not more than 6 to 8 inches

for the feet to tread. Coal, earth and rock are scraped into small baskets which are pulled by ropes by a coolie who mounts on the rungs of the ladder, with the basket sliding on the side-bars after him. The coal is deposited in a heap at the pit mouth and carried thence in baskets by coolies again to Ping Hsiang or some point on the river where it can be placed in junks.

The native mines are insufferably hot, due to the entire absence of any ventilation system, to the small caliber and single bore of the shafts, and to the large number of persons at work in the mines at once. The average is 30 to 35 degrees Centigrade. This temperature, with the darkness and abundant moisture, favors the growth of parasites such as the hookworm, which here finds ideal conditions for propagation. Some of these mines have a daily output of 30 to 40 tons, but most are much smaller. The coal districts are thickly dotted with native mines, but all are most superficial, and where the seams dip away from the surface they have not been touched. No natural gas or oil has so far been found in the south Yang Tze coal fields, but no deep borings have as yet been made.